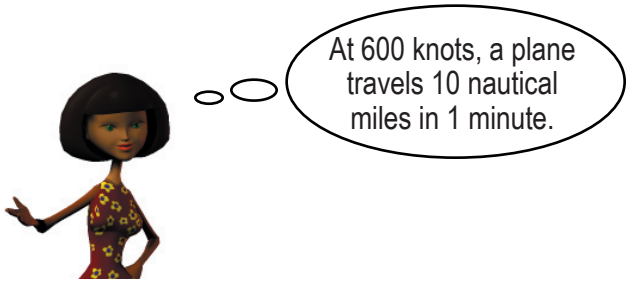
LineUp With Math™

Math-Based Decisions in Air Traffic Control

Student Workbook D

- **Understanding the Effects of Differences in Speed**
  - **Plot distances traveled at different speeds**
  - **Change knots to nautical miles per minute**



Investigator: _____

An Airspace Systems Program Product

Introduction to Travel at Different Speeds

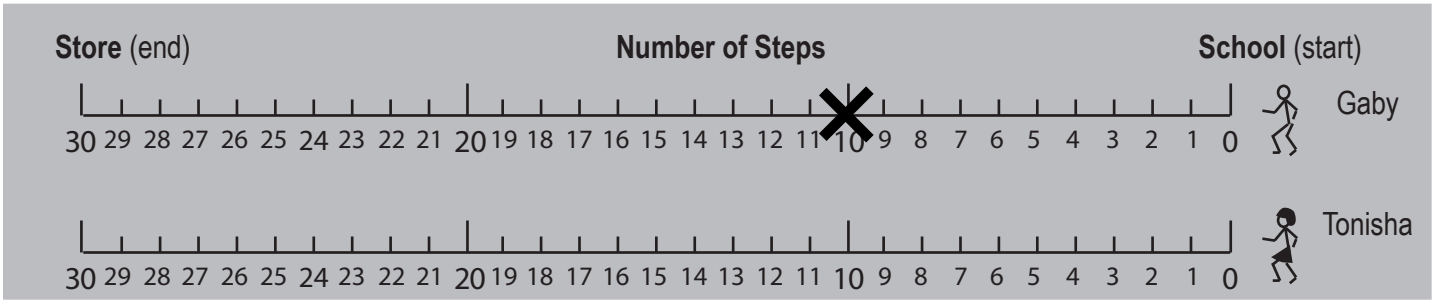
Investigator: _____

- Gaby and Tonisha are walking from school to a store. (Neither has a "headstart.")
- Each walks at a different speed (steps/minute) as shown in the speed table.
- Gaby and Tonisha each take the same size steps.

Speed Table

Name	Speed
Gaby	10 Steps/minute
Tonisha	9 Steps/minute

1 The number of steps that Gaby takes in 1 minute is: [ ] steps Tonisha: [ ] steps



- On Gaby's line, an ✕ is shown where he will be in 1 minute.

3 On Tonisha's line, put an ✕ where she will be in 1 minute.

4 How many steps is Tonisha behind Gaby after 1 minute? [ ] steps

4 Mark Gaby's position and Tonisha's position after 2 minutes.

5 How many steps is Tonisha behind Gaby after 2 minutes? [ ] steps

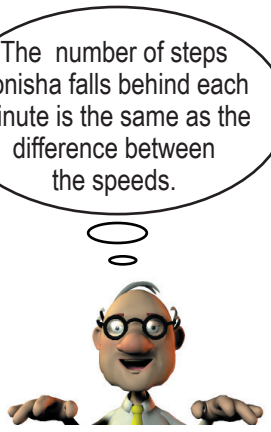
6 Mark Gaby's position and Tonisha's position after 3 minutes.

7 How many steps is Tonisha behind Gaby after 3 minutes? [ ] steps

8 How many steps does Tonisha fall behind Gaby **each** minute? [ ] steps per minute

9 How many steps would Tonisha fall behind in 5 minutes? [ ] steps

10 If Tonisha takes 8 steps per minute, how many steps would she fall behind Gaby in 5 minutes? [ ] steps



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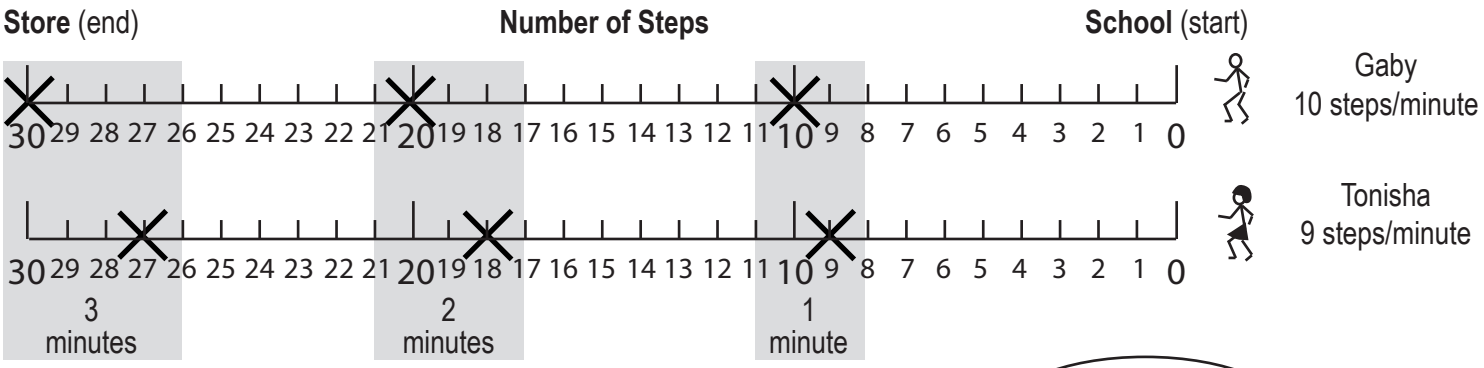
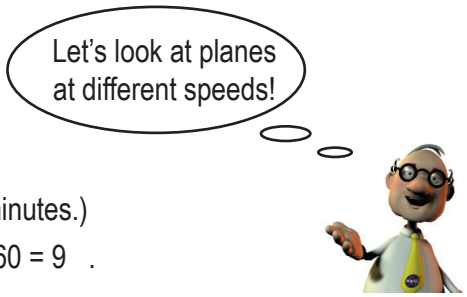
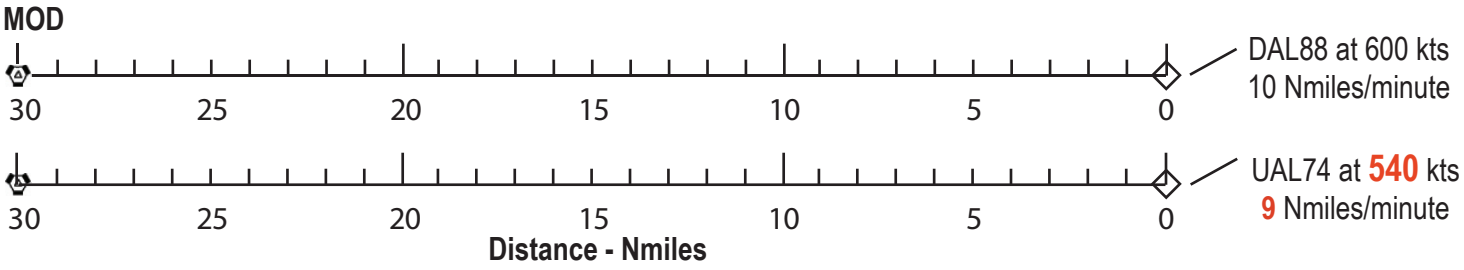
Investigator: _____





- DAL88 and UAL74 are each **30** Nmiles from MOD.
- DAL88 is traveling at 600 kts. That's 10 Nmiles per minute.
  (In 1 minute, the plane travels 1/60th the distance it travels in 60 minutes.)
- UAL74 is traveling at 540 kts. That's 9 Nmiles per minute. 540 • 1/60 = 9 .



6 On the DAL88 line, put an X through the number of miles it will travel in 1, 2, and 3 minutes.

7 On the UAL74 line, put an X through the number of miles it will travel in 1, 2, and 3 minutes.

6 How many miles is UAL74 behind DAL88 after:

1 minute: ____ Nmiles 2 minutes: ____ Nmiles 3 minutes: ____ Nmiles

6 How many fewer nautical miles will DAL88 travel in **each** minute? ____ Nmiles per minute

7 When DAL88 has traveled 30 Nmiles to MOD, how many Nmiles behind is UAL74? ____ Nmiles

- **At 600 kts, a 60-knot speed drop causes a 1 Nmile distance drop *every 10 Nmiles*.**

End of Worksheet

Change Knots to Nautical Miles per Minute

Investigator: _____

Recall: 1 Knot = 1 Nautical Mile per Hour
1 Hour = 60 Minutes

- Since planes fly so fast, air traffic controllers need to make decisions in minutes.
- To do this they need to know how many nautical miles a plane will travel in 1, 2 and 3 minutes.

1 To change from nautical miles per hour (knots) to nautical miles per minute, divide by **60**.

Speed in knots (Nmiles/hour)	To change Knots to Nmiles per minute, divide by 60	Speed in Nmiles/minute
600 kts	600 ÷ 60 = 10	10 Nmiles/minute
540 kts	540 ÷ ☐ = 9	9 Nmiles/minute
480 kts	☐ ÷ ☐	= ☐ Nmiles/minute

In 1 minute, a plane travels 1/60th the distance it travels in 60 minutes.

2 In the table below, fill in the total distance a plane travels in the times shown for each speed.

	1 minute	2 minutes	3 minutes
600 kts	10 Nmiles	☐ Nmiles	☐ Nmiles
540 kts	☐ Nmiles	☐ Nmiles	☐ Nmiles

3 With a 60-knot speed *reduction*, how much *less* distance does the plane travel in the times below?

Speed Reduction	1 minute	2 minutes	3 minutes
60 kts	1 Nmile less	☐ Nmiles less	☐ Nmiles less

4 If a plane slows its speed by 60 knots, how many nautical miles *less* will it travel each minute? ☐ Nmiles less

- Controllers reduce speed in 60 knot steps because it is easy to remember this rule:

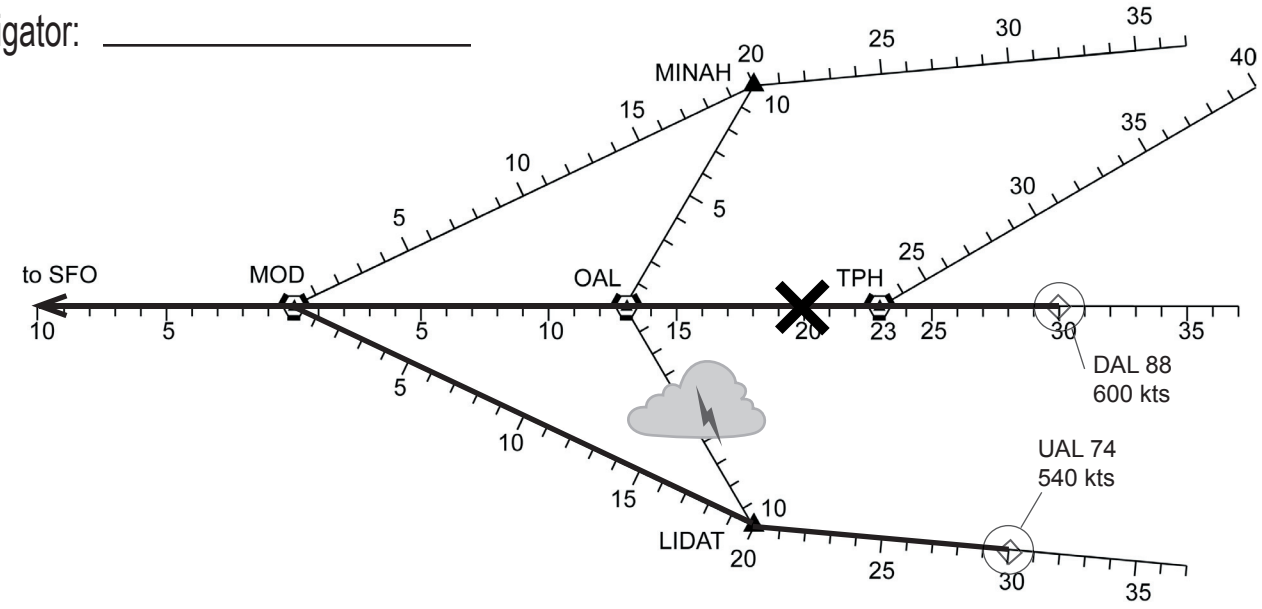
For every 60-knot drop in speed, there is a 1-Nmile drop in distance each minute.

5 A controller reduces a plane's speed from 600 kts to 540 kts. How many Nmiles *less* will the plane travel in 5 minutes? ☐ Nmiles less

End of Worksheet

Plot Distances for Different Plane Speeds

Investigator: _____



This table shows plane speeds.

Call Sign	Speed Knots	Speed Nmi per Minute
DAL88	600	10
UAL74	540	9

1. How many Nmiles does each plane travel in 1 minute? DAL88 [ ] Nmi UAL74 [ ] Nmi

2. For **each** plane, use an ✕ to plot its position at 1, 2, and 3 minutes. Put a 3 near each plane's 3-minute mark: ✕3

3. How many Nmiles does UAL74 fall behind DAL88 each minute? [ ] Nmiles per minute

4. Using the speed table, the difference in plane speeds **in Nmiles per minute** is: [ ] Nmiles per **minute**

5. The number of Nmiles that UAL74 falls behind each minute is the
   ☐ same as ☐ different than the difference between plane speeds in Nmiles per minute.

6. How far will UAL74 fall behind in 3 minutes? [ ] Nmiles

7. Suppose the difference in speed is 2 Nmi/minutes.
   - How far would UAL74 fall behind in 3 minutes? [ ] Nmiles
   - How many minutes will it take UAL74 to fall 8 Nmi behind? [ ] Minutes

End of Worksheet